

PHYSICS AND CHEMISTRY OF MINERALS

In Cooperation with the International Mineralogical Association
(IMA)

Volume 3 · 1978

Edited by S.S. Hafner, A.S. Marfunin, C.T. Prewitt

T.J. Ahrens, Pasadena

A. Authier, Paris

P.M. Bell, Washington

G.B. Bokij, Moscow

V. Gabis, Orléans la Source

G.V. Gibbs, Blacksburg

T. Hahn, Aachen

H. Jagodzinski, Munich

J.C. Jamieson, Chicago

N. Kato, Nagoya

R.C. Liebermann, Stony Brook

J.D.C. McConnell, Cambridge,
U.K.

A.C. McLaren, Clayton

N. Morimoto, Osaka

A. Navrotsky, Tempe

R.E. Newnham, University Park

A.F. Reid, Port Melbourne

R.D. Shannon, Wilmington

I. Sunagawa, Sendai

D.W. Strangway, Toronto

R.G.J. Strens, Newcastle upon
Tyne

V.M. Vinokurov, Kazan

E.J.W. Whittaker, Oxford

B.J. Wuensch, Cambridge,
Massachusetts



Springer International

Physics and Chemistry of Minerals

The exclusive copyright for all languages and countries, including the right, for photomechanical and any other reproductions, also in microform, is transferred to the publisher.

The use of registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Springer-Verlag, Berlin · Heidelberg · New York

Printers: Universitätsdruckerei H. Stürtz AG, Würzburg

Printed in Germany — © by Springer-Verlag Berlin-Heidelberg 1978

Contents of Volume 3, 1978

Number 1 issued on June 28, 1978

- 1 K. Iishi**
Lattice Dynamics of Corundum
- 11 I. Jackson, R.C. Liebermann, A.E. Ringwood**
The Elastic Properties of $(\text{Mg}_x\text{Fe}_{1-x})\text{O}$ Solid Solutions
- 33 C.M. Scala, D.R. Hutton, A.C. McLaren**
NMR and EPR Studies of the Chemically Intermediate Plagioclase Feldspars
- 45 A. Julg**
An Empirical Relation Between Hardness and Bond-Ionicity in a Crystal
- 55 Abstracts of Papers held at the IMA Symposium Physics of Minerals, Novosibirsk, USSR, 1978**

Number 2 issued on August 28, 1978

- 97 T. Yagi, H.-K. Mao, P.M. Bell**
Structure and Crystal Chemistry of Perovskite-Type MgSiO_3
- 111 S. Okajima, I. Suzuki, K. Seya, Y. Sumino**
Thermal Expansion of Single-Crystal Tephroite
- 117 H. Bill, G. Calas**
Color Centers, Associated Rare-Earth Ions and the Origin of Coloration in Natural Fluorites
- 133 M.T. Vaughan, D.J. Weidner**
The Relationship of Elasticity and Crystal Structure in Andalusite and Sillimanite
- 145 C.G. Dodd, P.H. Ribbe**
Soft X-Ray Spectroscopy of Ferrous Silicates
- 163 A. Ball, S. White**
On the Deformation of Quartzite
- 173 E. Dowty**
Absorption Optics of Low-Symmetry Crystals-Application to Titanian Clinopyroxene Spectra
- 183 A. Putnis**
The Mechanism of Exsolution of Hematite From Iron-Bearing Rutile
- 199 G.J. Clark, C.W. White, D.D. Allred, B.R. Appleton, I.S.T. Tsong**
Hydrogen Concentration Profiles in Quartz Determined by a Nuclear Reaction Technique

Number 3 issued on October 31, 1978

- 213 **L.V. Nikolskaya, V.M. Terekhova, M.I. Samoilovich**
On the Origin of Natural Sapphire Color
- 225 **D.S. Goldman, G.R. Rossman, K.M. Parkin**
Channel Constituents in Beryl
- 237 **G.A. Lager**
A Novel Technique for Characterizing Thermal Expansion in Minerals
- 251 **H.F. Wang**
Elastic Constant Systematics
- 263 **H. Ried, M. Korekawa**
Twinning and Exsolution in an Antiperthite
- 271 **R.M. Abu-Eid, K. Langer, F. Seifert**
Optical Absorption and Mössbauer Spectra of Purple and Green Yoderite, a Kyanite-Related Mineral
- 291 **L.-g. Liu**
High Pressure Ca_2SiO_4 , the Silicate K_2NiF_4 -Isotype With Crystalchemical and Geophysical Implications
- 301 **Abstracts of Papers held at the IMA Symposium Physics of Minerals, Novosibirsk, USSR, 1978**

Number 4 issued on December 21, 1978

- 309 **S.H. Kirby, M.W. Wegner**
Dislocation Substructure of Mantle-Derived Olivine as Revealed by Selective Chemical Etching and Transmission Electron Microscopy
- 331 **J. Amossé**
Physicochemical Study of the Hubnerite-Ferberite (MnWO_4 – FeWO_4) Zonal Distribution in Wolframite ($\text{Mn}_x\text{Fe}_{(1-x)}\text{WO}_4$) Deposits. Application to the Borralha Mine (Portugal)
- 343 **G. Smith**
A Reassessment of the Role of Iron in the 5,000–30,000 cm^{-1} Region of the Electronic Absorption Spectra of Tourmaline
- 375 **G. Smith**
Evidence for Absorption by Exchange-Coupled Fe^{2+} – Fe^{3+} Pairs in the Near Infra-red Spectra of Minerals

Author-Index of Volume 3, 1978

- Abu-Eid, R.M. 271
Allred, D.D. 199
Amossé, J. 331
Appleton, B.R. 199

Ball, A. 163
Bell, P.M. 97
Bill, H. 117

Calas, G. 117
Clark, G.J. 199

Dodd, C.G. 145
Dowty, E. 173

Goldman, D.S. 225

Hutton, D.R. 33

Iishi, K. 1

Jackson, I. 11
Julg, A. 45

Kirby, S.H. 309
Korekawa, M. 263

Lager, G.A. 237
Langer, K. 271
Liebermann, R.C. 11
Liu, L.-g. 291

Mao, H.-K. 97
McLaren, A.C. 33

Nikolskaya, L.V. 213

Okajima, S. 111

Parkin, K.M. 225
Putnis, A. 183

Ribbe, P.H. 145
Ried, H. 263
Ringwood, A.E. 11
Rossman, G.R. 225

Samoilovich, M.I. 213
Scala, C.M. 33

Seifert, F. 271
Seya, K. 111
Smith, G. 343, 375
Sumino, Y. 111
Suzuki, I. 111

Terekhova, V.M. 213
Tsang, I.S.T. 199

Vaughan, M.T. 133

Wang, H.F. 251
Wegner, M.W. 309
Weidner, D.J. 133
White, C.W. 199
White, S. 163

Yagi, T. 97
- Abstracts of Papers held at
the IMA Symposium Physics
of Minerals, Novosibirsk,
USSR, 1978 55, 301

Subject Index*

- Absorption optics**
 cf. optical absorption spectra
- actinolite** 84
actinolitic hornblende 84
alamosite PbGeO_3 83
albite 70, 77, 304, 305
alkalifeldspars $(\text{Na}, \text{K})\text{AlSi}_3\text{O}_8$ 57, 78, 303, 305
almandine 56
aluminophosphate 62
aluminosilicate 59, 62, 64, 67, 133
amesite 69
amethyst 92
amphibole 84, 302
analbite 77
andalusite 59, 133
andesine 37
andradite 56
anorthite 77, 304
antiphase domains 70
antiperthite 263
apatite 60, 84
aquamarine 225
astrakhanite 83
 zinc astrakhanite $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4(\text{H}_{1.06}\text{D}_{0.94})\text{O}$
 84
- Beidellite** 75
beryl 82, 87, 225
beryllosilicate 62
biotite 84, 301, 303, 375
borralha deposit 331
Brillouin scattering 133
brucite 79
bytownite 33
- Calcium amphibole** 84
calcium feldspar 78
calcium germanate Ca_2GeO_4 291
calcium silicate Ca_2SiO_4 291
carbonatite 61
celadonite 58
channels
 beryl 225
 hollandite 85
charge compensation 213
chemical bond 45
chemical etching
 olivine 309
chlor apatite 60
chondrites 78
chrysotile 79
- clathrates** 67
clay 63
clinoenstatite MgSiO_3 97
clinopyroxene 173, 301
cobalt silicate $\text{CoSiO}_3, \text{Co}_2\text{SiO}_4$ 81
coesite 86
color
 beryl 87, 225
 fluorite, natural 117
 sapphire, natural 213
 sodalite 65
 spodumene 93
 titanian pyroxene 173
cordierite 303
cornelian 82
coronadite 85
corundum 1
cotunnite PbCl_2 83
cristobalite 89
cryptomelane 85
crystal chemical 86, 97, 291
crystal field effect 97
crystal structure
 andalusite 133
 calcium silicate Ca_2SiO_4 291
 emeleusite 72
 labradorite 74
 perovskite-type MgSiO_3 97
 protolittonite 91
 sillimanite 133
 cuprite Cu_2O 92
 curite 93
- Defects**
 amethyst 92
 feldspar 78
 quartz 91
deformation mechanism
 quartzite 163
diamond 61
 dickite 75
diopside 60
 dioptase $\text{Cu}_6/\text{Si}_6\text{O}_{18}/\cdot 6\text{H}_2\text{O}$ 83
 dislocations
 olivine 309
 dislocation climb
 quartzite 163
 disorder
 cf. order-disorder
 disthene 59
 dunites 90

* All mineral names occurring in titles, subtitles and abstracts are indexed. Also indexed are revised key words submitted by the authors

- E**arth's mantle 56, 97, 291, 309
 elastic constants
 andalusite 133
 corundum 1
 garnet 56
 magnesiowüstite 11
 sillimanite 133
 systematics 251
 electric field gradients
 ilvaite 56
 layer silicate 58
 olivine 68
 electronic charge in crystals 45
 electron microscopy 263, 309
 electron paramagnetic resonance (epr)
 alkalifeldspars 78
 fluorites, natural 117
 forsterite 88
 plagioclase 33
 quartz 92
 electron spin resonance (esr)
 cf. electron paramagnetic resonance (epr)
 electronic absorption spectra
 cf. optical absorption spectra
 emeleusite $\text{Na}_2\text{LiFe}^{III}\text{Si}_6\text{O}_{15}$ 72
 enstatite 60, 77, 306
 epidote 84, 303
 exchange-coupled pairs 213, 343, 375
 exsolution 183
 antiperthite 263
- F**abrics
 quartz 163
 fayalite 95
 feldspar 33, 57, 63, 78, 85, 86, 263, 303, 305
 feldspaths
 cf. feldspar
 feldspathoides 67
 ferberite FeWO_4 331
 ferromagnesium silicate 301, 302
 ferrosillite 306
 ferrous silicates Fe_2SiO_4 , FeSiO_3 145
 fluor apatite 60
 fluorite CaF_2 64
 natural 117
 forsterite Mg_2SiO_4 88
- G**alena PbS 92
 galozones 183
 garnet 56, 60, 68, 301, 375
 $(\text{Mg}, \text{Fe})_3\text{Al}_2\text{Si}_3\text{O}_{12}$ 26
 germanate 81, 84
 glauconite 58
 granite 306
 grossular 56
 growth defects
 cf. defects
- H**ardness 45
 hematite 183
 high pressure
 calcium silicate 291
 ilvaite 55
 magnetite 66
 olivine 89, 90
 perovskite-type MgSiO_3 97
 troilite 72
 hollandite $\text{A}_x\text{M}_6(\text{O}, \text{OH})_{16}$ ($x \leq 2$) 62, 85
 hubnerite MnWO_4 331
 hubnerite-ferberite zoning 331
 hydrogen content
 quartz 199
 hydrothermal synthesis 75
 hydroxyl apatite 60, 84
 hydroxyl sodalite 83
- I**Ilvaite $\text{CaFe}^{2+}\text{Fe}^{3+}(\text{Si}_2\text{O}_7\text{OH})$ 55
 inclusion formation 67
 information storage and display 64
 infrared absorption (ir) spectra 67, 82, 84, 375
 infrared, optical 82, 375
 ion beam 199
 ion exchange centers
 aluminosilicate-type 62
 oxide-type 62
 uranophosphate-type 62
 zirconosilicate-type 62
 ionicity 45
 iron pairs 343, 375
 irradiation
 beryl 225
 isomorphism
 $\text{Fe}^{2+}-\text{Al}^{3+}$ 213
- K**aolinite 75
 katapleite $(\text{Na}_2, \text{Ca})(\text{ZrO}_3)(\text{SiO}_4)_3 \cdot 2\text{H}_2\text{O}$ 62
 K_2NiF_4 -isotype 291
 kyanite Al_2SiO_5 86, 271
- L**abradorite 33, 69, 74
 lattice-dynamics
 corundum 1
 lead selenide PbSe 92
 lead telluride PbTe 92
 lovdarite 62
 luminescence
 spodumene 92
- M**agnesiowüstite $(\text{Mg}_x\text{Fe}_{1-x})\text{O}$ 11
 magnesite 79
 magnesium germanate Mg_2GeO_4 81
 magnesium silicate Mg_2SiO_4 291
 magnetite Fe_3O_4 66
 manganese oxide 63

- mantle
 cf. earth's mantle
- metahalloysite 75
- metasomatises 78
- meta-torbernite 93
- meteorites 78
- mica 79, 84, 91, 302
 Na-K-mica-montmorillonite 75
 NH₄-mica 75
- microcline 305
- milarite 72
- Mössbauer spectra
 cf. nuclear gamma ray resonance spectra
- muscovite 75, 79
- N**acrite 75
- natrolite Na₂(AlO₂)₂(SiO₂)₃ · 2 H₂O 62
- nemalite 79
- nepheline 303
- neutron diffraction 83
- nickel silicate Ni₂SiO₄ 81
- nuclear gamma ray resonance (ngr) spectra
 beryl 225
 germanate Ca_{1-x}Fe_{1+x}GeO₃ 84
 ilvaite 55
 layer silicates 58
 magnetite 66
 trollite-pyrrhotite 82
 yoderite 271
- nuclear magnetic resonance (nmr) spectra
 inclusion compounds 67
 olivine Mg₂SiO₄ 68
 plagioclase feldspars 33
- O**ligoclase 35, 37
- olivine 60, 77, 89, 90, 94, 95, 237, 302, 309
 (Mg,Fe)₂SiO₄ 28
 Mg₂GeO₄ 81
 Mg₂SiO₄ 68
 Fe₂SiO₄ 68
 Ni₂SiO₄ 81
 spinel transition 81
- omphacite 61
- optical absorption spectra
 beryl 87, 225
 biotite 375
 fluorite, natural 117
 sapphire, natural 213
- titanian clinopyroxene 173
- tourmaline 343, 375
- yoderite 271
- order-disorder
 alkalifeldspar 305
- orthoclase 305
- orthoferrite-type 97
- orthopyroxene 81, 303
- otenite Ca(UO₄)(PO₄) · 8 H₂O 62
- oxides
 elastic constants 11, 251
 ion exchange centres 62
- P**alygorskite 63
- parachrysotile 79
- paragonite 75
- paramagnetic centres
 cf. defects
- pegmatites 78, 91, 92
- periclase MgO 89, 97
- periodotite xenoliths 309
- perovskite 90, 97
 CaSiO₃ 291
- phase transition
 alkalifeldspar 57
 inclusion compounds 67
 kaolinite 75
 K₂NiF₄-type 291
 layer silicates 75
 muscovite – phlogopite 75
 olivine – spinel 81
- phenocrysts 306
- phlogopite 75, 84
- plagioclase 33, 60, 69, 76, 263, 303
- potassium feldspar 78, 263, 305
- protolittonite 91
- psilomelan-todorokite 63
- pyralspite 56
- pyrope 56
- pyroxene 78, 94, 173, 237
 CoSiO₃ orthopyroxene 81
 orthopyroxene 28, 302, 304
- pyrrhotite 82
- Quartz SiO₂ 80, 81, 89, 91, 199
- quartzite 163
- R**ectorite 75
- redledgeite 85
- ringwoodite 89
- rutile 183
- S**anidine 305
- sapphire 213, 375
- satellite reflections
 labradorite 69
 schorl 343
- serpentines 75
- silicate perovskite MgSiO₃ 97
- silicate spinel Co₂SiO₄ 81
- sillimanite 59, 133
- sodalite Na₂Al₆Si₆O₂₄X₂ 65
 hydroxyl sodalite 83
- sodium feldspar 78
- soft X-ray spectroscopy
 cf. X-ray spectra

- solid solution
 $(Mg_xFe_{1-x})O$ 11
 garnets 56
 solid solution thermodynamics
 alkalifeldspars 303, 305
 biotite 304
 cordierite 304
 epidote 304
 ferromagnesium silicates 301, 302
 hubnerite-ferberite 331
 nepheline 303
 orthopyroxene 304, 306
 plagioclase 304
 spectromechanical analyzer 199
 spessartine 56
 spinel 60
 $(Mg,Fe)Al_2O_4$ 27
 $(Mg,Fe)_2GeO_4$ 27
 $(Mg,Fe)_2TiO_4$ 27
 silicate spinel 81
 spodumenes 92
 staurolite 301
 stishovite SiO_2 81, 86, 90, 97
 strain analysis 237
 strontium plumbate 90
 structure
 alamosite 83
 amesite 69
 astrakhanite 83
 cotunnite 83
 dioprase 83
 hydroxyl apatite 83
 hydroxyl sodalite 83
 plagioclase, heat treated 76
 superstructure
 labradorite 74
 syenites 78
 symmetry in silicates 67
tenorite CuO 92
 tephroite Mn_2SiO_4 111
 thermal expansion
 oxides 237
 silicates 237
 tephroite 111
 titanium 173
 titanian clinopyroxene 173
 titanian garnet 375
 titaniferous garnet 381
 titanosilicate 62
 topaz 59, 82, 91
 torbernite 93
 tosudite 75
 tourmaline 82, 343, 375
 transmission electron microscopy (tem)
 cf. electron microscopy
 tremolite 246
 troilite FeS 72, 82
 tuhualite 72
Ugrandite 56
 ultraviolet
 cf. optical
 upper mantle
 cf. earth's mantle
 uranite 63
 uranophosphate 62
Velocity-density relations 251
Wadeite $KSi[Si_3O_8]$ 86
 water weakening
 quartzite 163
 wolframite $Mn_xFe_{1-x}WO_4$ 331
 wüstite FeO 11
X-ray spectra
 aluminosilicate 59
 antiperthite 263
 apatites 60
 ferrous silicates 145
 inclusion compounds 67
 nemalite 79
 olivines 95
 perovskite-type $MgSiO_3$ 97
 plagioclase feldspars 76
 silicates 59
 troilite-pyrrhotite 82
Yoderite 271
Zektzerite 72
 zeolite 63, 67
 zirconosilicate 62

